1. REPORT DATE **30 SEP 1997**	2. REPORT TYPE	3. DATES COVERED **00-00-1997 to 00-00-1997**
4. TITLE AND SUBTITLE **Studies Related to the Scattering of Acoustic Waves by Random Sound-speed Fluctuations and Rough Boundaries in a Shallow Channel**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Catholic University of America,Department of Electrical Engineering,Cardinal Station,Washington,DC,20064**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a REPORT **unclassified**	b ABSTRACT **unclassified**	c THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

STUDIES RELATED TO THE SCATTERING OF ACOUSTIC WAVES BY RANDOM SOUND-SPEED FLUCTUATIONS AND ROUGH BOUNDARIES IN A SHALLOW CHANNEL

Mark J. Beran
Dept. of Electrical Engineering
The Catholic University of America
Cardinal Station
Washington DC 20064
Tel: (202) 319-5193, Fax: (202) 319-5195
E-mail: beran@cua.edu
Award No. N00014-96-0987

LONG TERM GOALS

The purpose of this research is to determine the effects of an absorptive channel bottom and piecewise linear sound-speed profiles on the volume and surface scattering in a shallow channel. Ultimately, we wish to determine the distorting effects of scattering on communications and imaging in a realistic channel.

SCIENTIFIC OBJECTIVES

We have developed the basic coherence equations governing the propagation of acoustic radiation in a channel with volume and surface scattering. We have included the effects of bottom absorption and a sound-speed profile. We have shown the difference between two- and three-dimensional channels. Solving the coherence equations numerically has allowed us to determine the intensity distribution of the radiation at any point in the channel. In related work, we have also developed the governing equations for the fourth-order coherence equations and the two-frequency coherence equations.

APPROACH

The current work was done by a Ph.D student, Thomas Barnard, and was funded under an ASSERT grant which financed the completion of his thesis. He used the method previously introduced by the principal investigator and S. Frankenthal to extend the theory to include the effect of an absorptive bottom and a piecewise linear sound-speed profile on volume scattering in a shallow channel.

WORK COMPLETED

Mr. Barnard successfully introduced the effect of an absorptive bottom and a piecewise linear profile into the coherence equations governing the propagation of acoustic radiation in a shallow channel with scattering. He has shown the difference between two- and three-dimensional formulations and performed a series of numerical calculations. He is currently completing the writing of his Ph.D. thesis and expects to present it to the engineering faculty at The Catholic University of America in February, 1998.

RESULTS

The results enable the assessment of the effect of an absorptive bottom and a linear sound-speed profile on the volume scattering in a shallow channel. Of particular importance is the effect of bottom absorption on the transverse scattering in the channel. In the research, methods have been developed to obtain numerical results for this three-dimensional effect.

IMPACT/APPLICATIONS

The results of this research can predict the effect of bottom absorption and a linear sound-speed profile on scattering in a shallow channel. This scattering distorts communication and imaging systems in a shallow channel. The effect can now be studied quantitatively using data about the correlation function of the index-of-refraction fluctuations in the channel.

RELATED PROJECTS

This research is closely related to the propagation of pulses in shallow channels where scattering is an important effect. In the pulse case, the basic theory has been developed and numerical calculations are underway without bottom and sound-speed profile effects. In the future, it is planned to include the results of Mr. Barnard's research in the pulse problem.

REFERENCES

Mark J. Beran and Shimshon Frankenthal, Volume scattering in a shallow channel, J. Acoust. Soc. Am., 91, 3203-3211 (1992)

Mark J. Beran and Shimshon Frankenthal, Combined volume and surface scattering in a channel using a modal formulation, J. Acoust. Soc. Amer. 100, 1463-1472 (1996)